THE PRINCIPLES

AND

PRACTICE OF PHOTOGRAPHY

FAMILIARLY EXPLAINED.

COMPRISING

A COURSE OF EASY AND FAMILIAR LESSONS

ON

THE COLLODION PROCESS;

PRINTING ON PLAIN AND ALBUMENIZED PAPER;

HOW TO PRODUCE LIFE-SIZE PORTRAITS.

DRY-PLATE PHOTOGRAPHY:

COLOURING AND MOUNTING PHOTOGRAPHS;
DEFECTS, FAILURES, AND REMEDIES,
&c &c. &c.

By C. JABEZ HUGHES.

LONDON: PUBLISHED BY THE AUTHOR,
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1861.

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FAMILIARLY EXPLAINED.

CONTAINING

THE POSITIVE COLLODION PROCESS; THE NEGATIVE COLLODION PROCESS; PRINTING ON ALBUMENIZED PAPER, AND TONING BY THE NEUTRAL GOLD PROCESS; COPYING PICTURES SO AS TO ENLARGE OR REDUCE THEM; LIFE-SIZE PORTRAITS, AND HOW TO PRODUCE THEM BY THE SOLAR CAMERA.

DRY-PLATE PHOTOGRAPHY;

INCLUDING

THE COLLODIO-ALBUMEN, FOTHERGILL, AND TANNIN PROCESSES. HOW TO COLOUR AND MOUNT PHOTOGRAPHS. "WATERHOUSE" AND OTHER DIAPHRAGMS IN LENSES, AND HOW TO USE THEM, &c

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PREFACE.

THE purpose of the present little work is to furnish a simple and easy introduction to Photographic practice.

The Writer has adopted the familiar style as being the nearest approach to oral teaching, and allowing the use of the plainest and most homely language in which to convey the instruction. The pupil has always been supposed to be at his elbow. The object has been to remove as many difficulties as possible from his path, and to render the commencement interesting. There has been no endeavour, however, to hide from him the real difficulties that he may encounter; he is rather prepared for them, and instructed how to meet some and to avoid others.

Little else is here aimed at beyond preparing the way for the profitable consideration of such works as Hardwich's "Photographic Chemistry," Sutton's "Dictionary of Photography," and Lake Price's "Photographic Manipulation;" all masterly treatises on their several subjects.

To obtain a complete insight into Photography, the pupil should study Hunt's "Researches on Light"—that unsuspected mine of Photographic riches—from

which he will gather how this marvellous Art has arisen, on what deep science it is based, and how vast its extent; and, to keep himself *au courant* with its daily, hourly progress, he should read the Photographic Journals, in which its constant triumphs are recorded.

To these latter—the Journals—is mainly due the vast diffusion of Photographic knowledge and widespread practice of the Art. They are so varied in their contents—the most elementary to the profoundest subjects being freely discussed—that the pupil can scarcely peruse a single number without obtaining valuable information; and no better advice can be given to the student who would perfect himself in the Art than to read them carefully.

The Author concludes with the hope that even this little Manual may not be without its influence in disseminating the knowledge and practice of the Fascinating Art.

C. JABEZ HUGHES.

379, *Oxford Street, March*, 1861.

HOW TO LEARN PHOTOGRAPHY.

PART I.

INTRODUCTION.

My dear Pupil,

I propose, in a simple and familiar manner, to introduce you to the wondrous and fascinating Art of Photography. I take it for granted that you are entirely unacquainted with it, and that you are very anxious to learn. Before proceeding, however, to the practical portion, I wish to impress on your mind a few of the leading principles. I would willingly omit this part of my instruction; but I see so many amateurs, and even professional photographers, who get into difficulties, because they do not commence with a clear idea of their subject; so that despite your natural impatience to get to work, I must beg your attention to this introductory chapter, as my desire is that you should not only practise the Art, but that you should understand it too.

If you acquire a knowledge of the general principles, you will not only avoid those difficulties that so frequently embarrass young photographers, but every step in your path will be rendered pleasant and interesting. Even your very failures, when you have a clue to them, instead of dis-

heartening you, will be stimulants to improvement—stepping-stones to success. I wish you to work, not blindly and impatiently for the result, viewing all the intermediate operations as irksome, but I want you to be interested in each stage of the process—to know why you have to do these things—to understand exactly when they are done properly—to be able to explain to any intelligent person the reason you do this and that, and what the result would be if any one thing were done differently.

If you follow the art as an Amateur, taking it up as a source of pleasure, this is the only course you can adopt; for by making each step a labour of love, whether you succeed or fail, you will certainly secure interesting amusement, and, by perseverance, you cannot fail to become sufficiently expert to have pleasure in blending your new acquirement with your other tastes and occupations—depicting bosom friends, multiplying choice engravings, copying rare works of art and vertu, as well as gaining health and vigour by rambling among those charming hills and dales to which your camera will invitingly entice you.

And should you encounter those frowns of fortune, from which we are none exempt, and have to seek other means of support than those you now happily enjoy, you may discover that you have made no unprofitable investment of time and means; for the period will never occur when a skilful and intelligent photographer may not so far profit by his knowledge as to gain a respectable subsistence.

If, however, you aim at once at being a professional, no matter what branch you attempt, unless you determine thoroughly to understand it, you have but an indifferent prospect. The days of rule-o'-thumb photography are rapidly passing away, and to avoid descending to the level of a

mere black-fingered mechanic, you must study hard to master your profession—the scientific part first, the artistic afterwards, and by their successful union you may look forward not only to competency, but even fame, as a reward for your well-applied talents.

Hoping that I have convinced you that, whether you follow the art for pleasure or profit, by studying its general principles you will secure a certain reward, I pass on to the subject itself.

The word PHOTOGRAPHY means drawing, engraving, or writing by Light.

You are, doubtless, aware that white light—light from the sun, for instance—is composed of three different colours—yellow, red, and blue; but you may not be aware that it possesses three distinct properties—Illuminating, Heating, and Chemical powers. These three powers are very singularly connected with the three colours. The Illuminating property exists mainly in the Yellow rays—the Heating property in the Red—and the Chemical in the Blue or Violet rays.

With the Illuminating power you are daily familiar; the July sun gives indubitable proof of its Heating power; and it is your present purpose to learn that all photography is based on its Chemical power.

For the full explanation of these facts I must refer you to Hunt's "Researches on Light;" but I mention, in illustration, that glass stained with copper and washed on one side with a colourless solution of alum, freely admits the rays of light, but obstructs 95 per cent. of heat; while a slice of black mica allows the heating, but prevents the light-giving rays to pass. Dark blue glass stops back almost entirely both heating and illuminating rays, but permits free passage to chemical or photographic power; and yellow or

orange glass, on the contrary, admits light and heat, but denies passage to the blue or photographic rays.

Strictly speaking, then, it is not LIGHT—*the illuminating agency*—that is the cause of photographic action, but an active principle associated with it, and which is connected principally with the weakest illuminating and even *invisible* rays. This PHOTOGRAPHING-POWER then, that is associated with Light, but which is *not* Light, is termed ACTINISM.

So essential is the explanation just given, that I wish you to re-read the preceding paragraphs; for it is necessary that you be impressed with the important fact—as true as it is startling—that pictures are not produced by LIGHT, but by this *Actinic Force*—not by the *visible*, but by the *invisible* agency of the sun.

If I have succeeded in establishing this principle in your mind, you understand the ground-work upon which all photography is based.

The daily experience of every photographer proves, that though these two active principles, Light and Actinism, are constantly associated together, yet that they often exist in very different proportions to each other. There may be a brilliant light with but moderate actinic power; or a dullish light and considerable photographic energy. In the autumn, when the sun's light and heat are at their maximum, the actinic power it by no means great. In winter, though the light be rather bright, the photographic power is always dull; while in early spring, before the sun has acquired his full strength, the actinic influence is relatively the most powerful in the whole year.

But in photographing from coloured objects, these facts will be more strongly impressed on your mind. When brilliantly lighted yellow objects "come out" dark, and dimly-

lighted blue ones appear bright, you will remember the reason; that the former reflect abundance of light, and but little actinism; whereas the latter throw back little light, but much actinism; and that Actinism, not Light, is the real picture-producing power.

The general term Photography embraces every description of picture produced by actinic means, whether on paper, silver plate, glass, or other material.

The primary idea pervading all photography is, the production of a chemical surface very easily disturbed by this actinic influence; and the various processes consist in the different applications of this leading principle.

Every photographic process consists essentially of four parts:

The Preparation of the Sensitive Surface.

The Exposure of the same to Actinism.

The Development, or making further evident the change produced.

The Fixing the image, so that the sensitive surface shall no longer be subject to solar power.

All the processes you hear and read of are only so many variations with different chemicals of these operations.

Photography, though so young, has already passed through several stages, and improved in every one; but the particular method I intend teaching you—the Collodion Process—has supplanted nearly all the others, it being not only the most perfect and comprehensive, but also the most simple.

For this reason I shall confine my instruction entirely to this process, recommending you first to master this one completely; and then, if you feel inclined to try some other, the knowledge you will have gained in perfecting yourself in this will materially aid you.

Pictures by this process are taken on glass, and are either

Positive or *Negative*. These terms will be explained hereafter, when the processes are described; and it is only necessary now, before we commence actual operations, to impress on you that photography, from beginning to end, is a series of delicate chemical experiments, the successful operation of which depends upon a number of apparently minute causes, which, if attended to, will produce the desired end; but which, if neglected, either from ignorance or carelessness, will as certainly cause failure and disappointment.

You must be very exact in mixing your solutions, and in using only perfectly clean vessels to put them in.

Cultivate the habit of noticing carefully all that you do; for as there is no such thing as *chance* in photography, you must clearly understand that when you fail, you do something different to when you succeed, and that this something *causes* the failure. As your natural desire is not to fail, you must try to discover the sources of failure that you may avoid them; and if you proceed in this manner you will certainly become a good and intelligent photographer.

THE APPARATUS AND CHEMICALS NECESSARY.

The first thing is to obtain a Set of Apparatus. Beginners too frequently get a common cheap one—made only to sell—and are surrounded with unnecessary difficulties from this cause alone. There is no necessity that it should be very expensive, but each article should be good of its kind. The quantity of apparatus you will require will in some degree depend on the branch to which you devote yourself. A set for producing the usual sized Glass Positives, will require the fewest articles. For the production of Negatives, and Printing from them on paper—a much higher branch of the art—more

apparatus will be required. Should you wish to be equally well furnished for producing Portraits and Landscapes, a full equipment will be required. The following comprises a complete set equally adapted for all purposes, together with a list of Chemicals, the quantities being calculated for about the $8\frac{1}{2}$ by $6\frac{1}{2}$ inches, or whole plate size. Should there be more articles enumerated than you think you will require, you must consult with some photographic friend, or explain to the person from whom you make your purchase, the description and size of pictures you wish to take, and you will be advised what articles to omit.

A Single Achromatic Landscape Lens.
A well-made accordion-body Landscape Camera.
A light, strong, but portable Tripod stand for ditto.
A travelling Glass Bath with water-tight top.
A portable Dark Tent, for landscapes.
A Double Achromatic Portrait Lens, fitted with "Waterhouse" central diaphragms.
A substantial square Mahogany Camera for in-door work.
A strong, well-made Camera Stand do. do.
A Head-rest for attachment to chair-backs.
A strong Iron ditto for standing figures.
Three plate boxes, 24 grooves, to suit the sizes of the camera.
Patent plate-glasses to fill the above.
Set of scales and weights, with glass pans.
1 Glass plate-cleaning holder.
1 or more Stout oak printing-frames.
1 Pneumatic plate-holder for large plates.
1 Developing stand for ditto.
2 or more Porcelain dishes.
1 Gutta-percha tray to be used for Hypo. Soda only.

1 Large and 1 small Glass Funnel.
1 Gutta-percha funnel, medium size.
1 Each 20 oz., 5 oz., 2 oz., and 60 minim, graduated glass measure.
1 Four oz. tall graduated collodion bottle.
1 Diamond for cutting glass plates.
1 Horn and 1 Boxwood pincers.
1 Silver-bath meter for estimating the strength of Silver Solution for Printing.
A few glass stirring rods.
Linen cloths, and clean chamois leather.
A few wide and narrow-mouthed corked and stoppered bottles.
Black velvet focussing cloth.

LIST OF CHEMICALS.

20 oz. Negative Collodion, Iodizing solution separate.
20 oz. Iodized Positive Collodion.
5 oz. Re-crystallised Nitrate of Silver.
1 oz. Pyrogallic acid.
1 oz. Citric acid.
1 lb. Protosulphate of Iron.
½ lb. Nitrate of Potash.
1 lb. Hyposulphite of Soda.
15 Grains Chloride of Gold.
4 oz. Kaolin.
4 oz. Cyanide of Potassium.
5 oz. Glacial Acetic acid.
5 oz. Alcohol.
1 oz. Carbonate of Soda.
1 Bottle Crystal Varnish.
1 do. Spirit do.

1 Bottle Dead-black Varnish.
1 do. Plate-cleaning Solution.
1 Quire highly albumenized paper.
1 „ plain positive paper.
1 „ white blotting-paper.
1 book Litmus paper.
1 packet of large round filter papers.
1 do. small.

It is not absolutely necessary that you should get the chemicals in exactly the quantities given above, and for sizes below 8½ by 6½ in. smaller portions will do; yet it is not well to begin with too small a stock, as from your inexperience you will be very apt to spill and waste a quantity at first, and your store will soon be exhausted; and if you reside in a country district you may experience a difficulty in obtaining articles sufficiently pure for your use. As a rule, it is better to buy them of those persons who supply photographic materials, from whom you will obtain them cheaper and better than from local chemists and druggists.

HOW TO PREPARE THE DARK ROOM.

Having selected your Apparatus and Chemicals, the next thing is to prepare a room in which to conduct your principal operations. This is technically called a *dark room*, though, except in a chemical sense, there is no reason that it be very dark.

Many persons imagine that any cupboard or out of the way corner will do to prepare plates in; this is a mistake, and if you can select a room sufficiently large in which you can move about freely, it will be much better than being cooped up and crippled in your actions. Moreover, in warm weather the

fumes from the chemicals will be injurious to your health, if the chamber be too small and ill-ventilated. Everything that can be spared should be removed from it, and nothing allowed to remain that can be injured by chemicals being spilt. It should be kept very clean, for dust and dirt are great enemies to good photography. Oil-cloth or bare boards are best for the floor, not carpet. A convenient range of shelves should be made round the room, and some hooks provided for hanging cloths and towels on.

You will remember I explained that the Actinic force that accompanies Light resides mainly in the blue and scarcely at all in the yellow rays, and photographers ingeniously take advantage of this fact by illuminating their "dark" rooms with this non-photographic light, and thus see how to prepare their most sensitive plates. Every aperture and chink that admits white light must be carefully stopped up.

If there be more windows than one they must be blocked out, and the remaining one covered with three folds of yellow calico; or better still, have a hinged frame made to cover the window, and glaze this frame with dark yellow or orange glass, so that you can have yellow or white light in your room at will.

Under the window a strong shelf or table should be placed to hold the bottles which you will require for developing and fixing; close at hand you must have a supply of water. If you can have the water laid on, with regular tap and sink, your arrangement will be perfect, failing this you may have a cask or other vessel with a tap in it, filling it up with water as you need, or on an emergency use a jug with a lip to it to pour from, and a pail to receive your slops. Have a towel and soap conveniently placed to wash your hands with.

HOW TO BEGIN WORK.

Your room being prepared, you are ready to make a commencement, and your natural desire will doubtless be to take a portrait.

But as you are a beginner you should commence with the easiest thing, and to take a portrait well is one of the most difficult in photography. The proper proceeding is to set up a plaster cast, engraving, porcelain statuette, or similar still-life object, and practise upon it, being prepared for many failures arising from your ignorance and clumsiness, before you attempt portraiture. You should try picture after picture, noticing carefully the faults you commit in one, so as to avoid them in the next.

In this way, by patience, observation, and practice you will speedily gain such experience as will make your new occupation a pleasure. Above all things do not expect to produce good pictures all at once; and be not discouraged with failures, but try to understand why you fail.

There is this advantage in setting up an inanimate object to copy, that the risks of failure are less, for it will not move or alter its expression, or make remarks if you do not succeed. When brother Tom, or friend Harry is called in to sit, the case will be different; they will be full of fun and jokes, will most likely move at the critical moment, and say disparaging things when they find the picture a failure. All this will confuse you, and cause you to omit things you ought to have done, and do abundance of things you ought not to have done, and dishearten you in your early progress.

You had better, therefore, set up a plaster cast bust—one

painted stone colour will be best—such as those of Shakespere, which are so abundant, and, using this as a model, work frequently at it until you have sufficient mastery of your instrument and materials to produce with moderate certainty a passably good picture; then you may proceed to portraiture.

Place your object in a good light, a glass-house built for the purpose is the best, but this you may not at present be able to obtain. A well lighted apartment will do, if you use a white screen—a sheet thrown over a clothes-horse—to reflect light upon the shaded side. A background may be formed by hanging some quiet drapery a little distance behind your object, and so far it is ready to be depicted.

Now get out your portrait lens, and after wiping carefully the surfaces of the glasses with a clean silk handkerchief or chamois leather, screw it on to your portrait camera, and place them both on your heavy camera stand opposite to your object. The ground-glass of your camera should have the sizes of the glass plates marked on it in squares, corresponding to the holders in your dark slide. Place your stand and camera so that the lens is opposite to about the centre of your object, and move the stand and camera backwards or forwards until the image of the bust is of the size, and occupies the place on your ground-glass that you wish the image to do on the plate you are going to use, remarking that the nearer the camera the larger the image, and *vice versâ*. Lay the focussing cloth on the camera; put your head under the cloth, and you will more clearly see the image on the ground-glass. Slide in or out the inner body of the camera until the image is seen quite distinctly, then fix the camera with the screw provided. While your head is still under the focussing-cloth, pass your hand round to the lens, and move the rack

backwards and forwards till you find the point at which it is most distinct. It is then said to be "in focus," or "sharp."

You may now return to your dark-room, and prepare your chemicals for "Glass Positives," these being the most easily produced photographs.

HOW TO TAKE GLASS POSITIVES.

THE chemicals required are—

Positive collodion.
Nitrate of Silver solution.
Plate-cleaning do.
Developing do.
Fixing do.

The Positive Collodion you will purchase ready for use; and as it retains its sensitiveness for a considerable time, you may safely keep a stock of it prepared ready for use. It is a good plan to keep this stock bottle of collodion in a cool place and away from the light. Handle it carefully, as there is always a sediment that forms. When required for use pour three or four ounces into the tall collodion bottle; and when you have done for the day return what remains back into the stock-bottle, that it may settle with the rest. In this manner you always use from a clear quantity, and avoid those spots and defects which arise from a turbid or unsettled collodion.

The nitrate bath solution is one of the highest importance. To know how much solution to mix, fill your bath with water to within an inch of the top, and measure how much it holds. Suppose it to contain 25 fluid ounces;* as 35 grains of

* It is important to notice that in all photographic formulæ, where ounces of liquids are named, that *fluid* ounces are meant, and that the glass measures are graduated for the purpose. When

nitrate of silver to one fluid ounce of distilled water is the proper strength, 2 ounces of the nitrate will be required to form 25 fluid ounces of the necessary solution. Dissolve the silver in 4 ounces of distilled water, or boiled rain water, then add half an ounce of positive collodion to it, shake it well for a few minutes, then add 21 ounces more of distilled water.

The solution will now be a pale milky colour, and after shaking up well, requires filtering. Should it not run through quite clear it must be re-filtered, and it is then fit for use.

Developing Solution.

Proto-sulphate of iron	100 grains.
Glacial acetic acid	¼ ounce.
Alcohol	¼ ounce.
Water	9 ounces.
Nitric acid	5 minims.

Dissolve the crystals, and if the solution be not quite clear, filter it, then add the alcohol and acids. It will keep good a considerable time, and may acquire a slight colour which is not of consequence; but when it turns decidedly brown it should be rejected.

solids are named, *Apothecaries* or *Troy* weight is meant. But the materials are sold to you by *Avoirdupois* weight; and as the ounce of the latter is not so heavy as that of the former, this fact must be carefully remembered, or disputes with shopkeepers, and errors in mixing your solutions, will arise. The ounce troy weighs 480 grains, and the ounce avoirdupois but 437½ grains. It is better, therefore, in mixing nitrate of silver solutions, to estimate the quantity required in *grains*, remembering that the purchased ounce of nitrate of silver will never contain more than 437½.

Fixing Solution.

Cyanide of Potassium	60 grains.
Water	6 ounces.

Dissolve and it is ready for use.

Let each of these solutions be distinctly labelled, and it is a good plan to put them in different shaped bottles, so that you may not mistake one for the other. Cork them well when they are out of use.

How to Clean the Glass.

Certain fixed sizes are used by photographers, and the glasses are sold cut ready for use.

It will be useful for you to know these dimensions, and how they are described.

1/9 or ninth	size means	$2\frac{1}{2}$ by 2	inches
1/6 „ sixth	„ ...	$3\frac{1}{4}$ by $2\frac{3}{4}$	„
1/4 „ quarter	„ ...	$4\frac{1}{4}$ by $3\frac{1}{4}$	„
1/3 „ third	„ ...	5 by 4	„
1/2 „ half plate	...	$6\frac{1}{2}$ by $4\frac{3}{4}$	„
1/1 „ whole	„ ...	$8\frac{1}{2}$ by $6\frac{1}{2}$	„

The larger sizes are described by stating their dimensions.

The description of glass, known as "Flatted Crown," is well suited for positives, and, before using, requires carefully cleaning. The sharp edges should be first removed with a fine file, or by drawing the edge of one piece over the edge of another; then lay the glass on a clean flat surface or put it in a "Plate-cleaning holder," and pour a few drops of the "Plate-cleaning solution" in the middle. Rub it carefully over every part with a bit of clean soft rag; turn it over, and do the other side the same. Then polish each side with a clean soft chamois leather kept expressly for this purpose.

Now breathe on the glass; and if the breath deposits evenly, the plate is clean. If the plate, however, show patches and marks, it must be re-cleaned. Let the edge be carefully wiped, and the plate is now ready for use. This amount of cleaning will generally be sufficient for new glass; but when the plates have been used, they require more labour. They must then be well washed under the tap to get rid of all collodion and chemicals, and be wiped on cloths kept expressly for the purpose. No soap, only plain soda and water, must be used in washing these cloths. Should the plates have been varnished, they must be soaked for some hours in a saturated solution of washing soda till the varnish and film come freely off. They must then be well washed, and treated as already described. Generally speaking, this proceeding will be sufficient; but occasionally plates will be found that require strong solution of Cyanide of Potassium or Nitric acid to get them clean. In these cases it will often be found quite as economical to break the glass at once, instead of wasting time and chemicals to clean a doubtful plate; for it is very annoying to find, after having gone through all the processes, finally to discover that the picture is spoiled because the glass has not been perfectly clean. It is a good plan to have a dish of water at hand, into which to place the spoilt pictures, and at the end of the day to wash them all, and put them away clean. By thus not allowing the films to dry on the glasses, they are much easier cleaned and fewer failures will arise from dirty glasses.

Collodion is a very good material for cleaning glasses when they are not very dirty. Pour a few drops on the glass, and well rub it with a clean cloth, and you will entirely remove all grease. A hint may be taken from this how to use up waste collodion.

POURING ON THE COLLODION.

Remove the stopper from the bottle, and wipe from the lip any dust, dirt, or dry film adhering; and holding the plate horizontally by one corner with the thumb and finger of the left hand, pour steadily into the middle of the plate as much collodion as will half cover it. Then gradually incline the plate so that the collodion flows to each corner, not allowing it quite to touch the thumb; then steadily pour back the excess from one corner into the bottle, and while the plate rests on the mouth of the bottle, move the plate backwards and forwards to prevent the collodion setting in lines. Perform this operation coolly and steadily, and try to avoid spilling any of the collodion. A little practice will make it come easy. The plate is now ready to be immersed in the nitrate of silver bath. Lift the dipper up, and place the back of your plate on it, it will adhere by capillary attraction; and immerse plate and dipper into the bath solution with one steady dip, and cover it over to keep it from light and dust. If there be the least hesitation or stop while the plate is being immersed, there will be a line marked across the plate. To know how long to keep the plate before putting it in the bath, after it is collodionized, is a point that you will gain by experience; but it depends on many circumstances, such as the nature of the collodion and the temperature; but this rule will guide you: if you put the plate in too soon, streaks and marks will be formed, commencing from where it first touched the silver solution. If you do not immerse it soon enough, the part of the plate that has become too dry will be insensitive, and will show a dark mark. By noticing these points, you can judge whether you have made any error in

the time of immersion. The plate must remain in the bath in summer time about two minutes, and in winter from five to ten.

While the plate is in the bath you must get ready your dark slide, and see that there is no dirt in it. Up to this point you may use white light; you must now shut your door, and see that only yellow light illuminates the room. Lift the plate up and down in the bath several times by means of the dipper, and the agitation of the solution will remove the oily-looking lines on the surface. Allow it to remain a little longer, in fact till all apparent greasiness is removed, and the film has become creamy-looking. Then take it off the dipper, and handling it as carefully as possible, chiefly by the corner uncollodionized, let it drain first into the bath, next on clean blotting paper, and then lay it, collodion side downwards, into your dark slide, the silver wire corners supporting it by the four corners. Close up your dark slide, and your plate is ready for use.

You may now return to your plaster cast, and glancing under the dark cloth see that the focus is not disturbed. Remove the ground-glass frame, and insert the dark slide in its place. Cover the lens with the cap, raise the shutter of the dark slide, and gently remove the lens cap, so as not to shake the camera; thus the light is admitted to the sensitive plate. Experience can alone determine the length of the "exposure." The brilliancy of the light, colour of object, kind of lens, nature of collodion, time of day, and even the period of the year, are all modifying circumstances.

Suppose you allow ten seconds. Count the time exactly, and replace the cap on the lens. Next shut down the shutter of the slide, and take it into the dark room. Closing the door, and noticing that no white light is admitted, remove the

plate as carefully from the dark slide as you put it in. The nitrate solution that has accumulated at the bottom, drain off with clean blotting paper. Put about an ounce of developing solution into a clean measure glass, and holding the plate horizontally by the uncollodionized corner, pour steadily but quickly along the bottom edge of the plate sufficient to easily cover it; gently incline the plate to allow the solution to flow uniformily backwards and forwards. Watch the "coming out" of the image. The image will quickly appear, first the parts most strongly lighted will shew themselves, next the shaded portions, and when these are fully out, turn off the solution and wash the plate well, by allowing the water from the tap to flow over it for not less than one minute, or until all the greasy lines disappear.

Lay the plate in a shallow gutta-percha dish kept for the purpose, and pour quickly over it sufficient of the fixing solution to cover it. Directly the yellow film of iodide of silver is dissolved, the plate must be lifted out and well washed. When the plate goes into the fixing solution, white light may freely be admitted. The fixing solution must be put back into its bottle, and may be used as long as it continues to dissolve the yellow film.

If the exposure were correct and you have developed properly, you will now have a nice picture of your bust.* Your plate may be dried spontaneously or by heat. When dry, pour on the *glass* side jet black varnish just as you did the collodion, and drain off at one corner, taking care it does not flow over to the face of the picture; or, better and easier, use a dead black varnish made expressly for the purpose, which is to be laid on with a brush, and which dries quickly, or may be

* If the picture be not perfect, refer to the chapter on Failures for further instruction.

assisted with heat. The collodion surface now requires varnishing to protect it from atmospheric action. Remove carefully with a camel-hair brush any dust or dirt on the picture, and pour crystal varnish over it as you did the collodion. Drain it, and when dry your picture is finished and ready to be mounted.

You have now passed through the various operations, and it only requires practice and observation to make them familiar with you. Having obtained this practice, the bust may be removed, and a friend being placed in its stead, you may, by applying the same manipulations, produce a portrait. Let him sit in an easy graceful position, and, if necessary, steady his head by the use of the head-rest. Let him look not at the light, but at some dark object. Allow him to wink his eyes freely during the sitting, but caution him to be quite steady in all other respects.

It is very desirable that you should know how to take glass positives, for circumstances often occur when that is the only kind of picture that can be obtained; it also affords you an easy introduction to photographic manipulation; yet, as speedily as possible, you must acquire the more valuable knowledge—how to take negatives.

One disadvantage of a positive is, that a separate sitting is required for every picture; and it may frequently happen that though you can obtain but one *seance*, you require a great number of impressions. This cannot be accomplished by the positive process; but if a *negative* be obtained, an unlimited number of impressions can be produced from a single sitting. Without, however, underrating the merits of glass positives, which stand unrivalled for ease, rapidity of production, and economy of time and means, you must pass on to the more valuable acquirement of producing negatives.

HOW TO TAKE NEGATIVES.

You must clearly understand the difference between a negative and a positive. Every glass picture, to a certain extent, partakes of the nature of both; but a positive is a picture done at one operation, and complete in itself, whilst a negative is not so much a picture as the means of producing one.

Positives are examined by reflected, negatives by transmitted light—the one you hold *down* to look *at*, the other you hold *up* to look *through;*—the former is black-varnished to make it opaque, the latter clear-varnished to give transparency. The one shows natural objects as they are—lights for lights and darks for darks—the other, just the reverse, faces, hands, and linen very dark, and black drapery quite clear. Hold a picture of each kind up to the light and look *through* them, the positive will appear thin and transparent, the negative dense and opaque; turn them down and look *at* them, the positive is clear and distinct, the negative misty and confused. The two kinds of pictures are so different, that you must judge each by its own rules; for what is a fault in one may be a merit in the other. In other words, a negative is a glass picture produced by somewhat similar means to a positive, only that in the development a much thicker and denser deposit is formed, so that on looking through it, the object is depicted just the opposite of what it is, whites are blacks, lights are darks, and rights are lefts.

In fact, the negative is to the photographer what the types are to the printer; and as the latter, you know, are arranged just the contrary of the impression that is taken from them, so must the photographer's negatives—his types—be the

reverse of his prints. The analogy between the two processes is so considerable, that the production of paper pictures by the aid of negatives is always termed "printing."

It will be a great assistance to you, if you can obtain from some photographer a negative that you can keep by you, to compare with your own, until you have acquired experience to know how to judge for yourself.

The same apparatus serves for the production of negatives as positives, but some of the chemicals are different; those that you require are—

Negative collodion
Nitrate of silver bath solution
Developing do.
Fixing do.

Negative Collodion is rather different in its preparation to positive, and is better adapted for giving dense pictures. It is generally supplied as plain collodion and iodizing solutions. It is made ready for use by mixing three parts by measure of the former to one of the latter, but as it does not usually retain its sensitiveness very well, more should not be mixed than you are likely to use within a week. It is better to mix it a few hours before using, so that time be allowed for floating particles to subside.

Nitrate of Silver Bath Solution.—The same you used for positives will also do for negatives. Fill it up from time to time with a plain solution of nitrate of silver, 40 grains to the ounce.

Developing Solution for Summer.

Pyrogallic acid	5 grains
Citric acid	2½ ,,
Distilled or boiled rain water	5 ounces

Developing Solution for Winter.

Pyrogallic acid	10 grains
Glacial acetic acid	100 minims
Distilled or boiled rain water	5 ounces

These solutions will remain good until they acquire a brown tint, when fresh should be mixed.

Fixing Solution.

Hyposulphite of soda ...	5 ounces
Water	5 „

This solution may be used until it loses its power of fixing the negative. It soon becomes discoloured, but that is of no consequence.

"Patent Plate" is the proper glass to use for negatives, as the "crown" is not flat enough. They require the same careful cleaning as for positives. As it is more difficult to produce clean negatives than positives, you had better accustom yourself to use a glass one size larger than you require, so that any defects, which usually occur on the margin of the plate, may not spoil your picture.

Pour the collodion on your plate, sensitize, drain, and place it in the dark slide as carefully as for positives.

The same difficulty occurs with negatives in giving any rule for the length of exposure; the appearance of the plate during development being a useful guide, but generally they require longer, sometimes twice as long time as for positives. Be very careful when your plate is in the dark slide, to keep it erect, and to handle it gently. Never knock it against anything, or it will be covered with abundance of spots from particles of dust and dirt falling on it. When in the dark

room, take the plate out as carefully as before, and remove with clean blotting-paper the nitrate solution that has accumulated at the bottom; and holding it by the corner, pour over it the developing solution, and in a few seconds the image will appear. After a little experience you will be able to judge, by the manner in which the image makes its appearance, whether you have given the proper exposure in the camera.

If it start out at once, directly the developer has flowed over the plate, the exposure has been too long; but if the image comes out slowly and reluctantly, and you have difficulty in making the deepest shades appear, it has not been exposed long enough.

The happy medium between these two is the correct time. When this has been given, the image makes its appearance steadily and gradually, first the high lights, next the light shades, and finally the deep shadows. Suppose it a portrait of a gentleman, the shirt front, face and hands are first seen, the light folds of the drapery next show themselves, and lastly, the details in the darkest parts. If it were a positive, you would have poured the developer off before these last were seen; but being a negative, you must carry it on until the whole of the details are clearly out, then pour the solution off the plate into your measure glass, and hold your plate up to the light. You will now see the image as a negative, the whites all dark, and dark portions nearly transparent; and if the picture appears in proper harmony, making allowance for reversed effects, what should be the lighter portions nearly opaque, and the darker parts very clear, *but the whole picture full of gradations and half-tone, with scarcely any parts entirely opaque, and very few clear glass*—the development is completed; but if the picture presents somewhat this appearance, and is deficient in opacity of deposit or "density," then add a

few drops of plain nitrate of silver solution to the developer, and after well mixing, pour back on the plate and continue the development. Examine it from time to time to observe progress. The developing solution soon gets discoloured, this is of no consequence; but when it becomes *turbid* or thick and muddy, throw it away and use fresh, to which you must add a few drops of the silver solution.

The second application rarely fails to produce the desired *density;* but should it not do so, you may continue the action of the developer until the required effect is obtained. This is, perhaps, the most difficult thing you have to learn—to know how far to go, and when to stop; how to gain intensity enough to produce a vigorous negative, and yet to avoid making it too dense, and losing half-tone. As a rule, beginners over-develop their positives, and under-do their negatives.

But it is possible to develop too much, and make the picture so dense that you cannot print through it. You must watch the kind of prints that different negatives produce, and when you find one that gives a brilliant yet soft image—for the real test of a negative is, the kind of print it produces —study that negative well, observe the degree of opacity it has, and, keeping it as a standard, try and produce all others like it. In this way you can train and educate yourself to produce good negatives.

The development being finished, wash the plate and lay it in the gutta percha dish; pour the fixing solution over, and when the yellow iodide is dissolved out, give it a careful and copious washing; for if any of the hyposulphite of soda remain in the film, it will crystallise and spoil it.

Your picture now being washed, you may calmly examine it. If it show as a moderately good but over-exposed positive, with a red and green pearly tint, and on looking

through is full of half tone both in the opaque and transparent parts, you may consider you have a correctly-exposed and well-developed negative, and one from which you may anticipate brilliant prints.

If, however, the negative appear as a good positive with brilliant blacks, but rather chalky whites, and on looking through it these latter are very dense without half-tone, and the former almost like bare glass, then your picture is defective, and will only produce a hard black and white print. The fault being that it was not long enough exposed in the camera.

Should it, however, appear as a very much over-exposed positive, the whole plate having a grey film over it, obscuring the image, and on looking *through*, the details of the shadows are almost as intense as the white linen, and the whole picture is deficient in contrast, then it has been over-exposed.

The two instances I have pointed out are extreme ones; it is your object to avoid each, but, of the two errors, under-exposure is the worst, for by careful printing you may get a passable proof from an over-exposed negative; but no dexterity will avail with an under-exposed one, and unfortunately, beginners' negatives, from their great desire to "work quick," have too frequently this latter fault.

HOW TO VARNISH THE NEGATIVE.

After the plate has been well washed and dried, it is ready to varnish. If only a few prints are wanted, and you do not intend to keep the negative, you may use crystal varnish, employing it as for a positive. If, however, you value your negative, and purpose producing many prints from it, the crystal varnish will not give sufficient protection, and you

must use a spirit varnish. There is a French article, Sœhnée varnish (pronounced *sennay*), that is very good indeed. To use this, or any other spirit varnish, warm the negative before a fire uniformly all over, as hot as the back of the hand will bear, then pour the varnish on like collodion, drain off and dry it with a similar heat. When cold your negative is ready to be printed from.

HOW TO TAKE NEGATIVES BY AN EASIER AND MORE CERTAIN METHOD.

The plan of taking negatives already described is the usual one, and when practised by experienced operators, produces the most perfect results; but there is another method getting into general use by which good negatives can be obtained with greater uniformity.

I recommend you to commence with the one I am about to describe, in preference to that which I have already given; as from the progress, which I may suppose you already to have made with positives, you will find this very simple and easy.

A positive collodion, giving a dense creamy film is required; if the one you are using is not of this character, mix an equal quantity of any good negative collodion with it, and after settling it will be ready for use. Collodionize your plate and sensitize in the usual bath; expose in the camera about half as long again as for a positive. Develop with the usual positive developing solution, only continue the action rather longer, that is, until all the details are distinctly seen; then wash well. The picture in this stage is like an over-exposed and over-developed positive, and on looking through is seen much denser than one, but not intense enough for a

negative, but every detail must be distinctly seen; next pour over the plate as much of the "Summer Developing Solution" as it will hold; when this has thoroughly mixed with the water on the plate, pour it back into the measure glass and add a few drops of the nitrate of silver solution to it, mix, and pour over the plate; it will speedily begin to intensify, that is, the silver will begin to be deposited over the various parts of the image *in the ratio that the light has acted.* Continue the development until the requisite intensity already explained is produced, then wash your plate and fix with either the cyanide or hyposulphite fixing solutions.

Negatives very soft and full of detail can be obtained by this process, when it would be extremely difficult to produce them by any other means.

Although it is not quite so important to obtain the same exactness of exposure in the camera in this as the preceding method, yet there is a certain margin beyond which you must not go. Nearly the same precautions apply as those I have already named.

If the various parts of the picture intensify in an equal manner, the dark drapery becoming nearly as dense as the head, and when fixed the whole plate is drab, and very little appearance of positive image, the exposure in the camera has been too long; but if the image becomes dense only in the parts reflecting most light, and even then takes the silver reluctantly, and when fixed shows as a good positive, the exposure has been too short.

The plate must be varnished in the manner already described.

HOW TO PRINT ON PLAIN OR ALBUMENIZED PAPER.

THE apparatus necessary for this operation are—

Printing-frames.
Porcelain dishes.
Silver-bath tester.
Gutta-percha dish.
American pegs.
Boxwood pincers.

The materials necessary for printing are—

Albumenized paper.
Plain salted do.
Nitrate of silver solution.
Kaolin.
Chloride of gold.
Carbonate of soda.
Hyposulphite of soda.

Albumenized Paper.—This material, like collodion, I do not recommend you to make, as you can purchase it ready prepared better than you can make it yourself. There are two principal kinds, known as *Rive* and *Saxe*. The former is a French paper, and has the highest glaze and finest surface; but the latter, a German one, is the most uniform in its general texture. Prints are also produced on plain paper, but the greater number are taken on the albumenized, on account of their superior clearness and brilliancy. For small pictures, particularly stereoscopics, this kind of paper is indispensable.

Plain paper requires preparing or "salting" before being ready for use, or it may be purchased already salted. It is not a difficult thing to "salt" your own paper. Procure

some sheets of Saxe or Towgood's paper, and immerse them for five minutes, removing air bubbles, in the following solution:—

Chloride of ammonium	100 grains
Chloride of barium	100 ,,
Citrate of soda	20 ,,
Water	20 ounces

Hang the sheets up to dry, and they are ready for the next operation. This may be performed in ordinary daylight.

Nitrate of Silver Solution.—You must make a fresh silver solution, as the one you have used for your positives and negatives is not adapted for printing, neither will the one you are about to make serve the former purposes, each must be kept for their separate uses. Measure how much fluid one of your porcelain dishes contains when filled half an inch high, and make so much nitrate of silver solution, 60 grains to the fluid ounce. The crystals have simply to be dissolved, and the solution is ready for use. It speedily becomes discoloured; but if you adopt the plan of keeping some kaolin, an ounce or two in a bottle, and pour your silver solution into it after each time of using, shaking it up well, the kaolin in subsiding will carry down with it the colouring matter, and leave your solution perfectly clear. It rapidly loses its strength, therefore, each time before using immerse the silver-bath meter, and note the figure on the tube where the surface of the fluid touches, and it will indicate, with sufficient accuracy for all practical purposes, the number of grains of nitrate of silver contained in each ounce of solution. Thus, if it stand at 30, 40, or 60, each ounce may be considered to contain so many grains of the nitrate. You must never sensitize your paper without being assured that your solution contains 60

grains per ounce. It is not sufficient that you originally mix it this strength, but it must be continued so, and until you have experience, you will scarcely believe how rapidly the silver salt is abstracted by the act of sensitizing the paper. If you adhere to the use of this little instrument, you will always be kept right; but never forget, that if this solution be not kept up to this strength, you cannot obtain brilliant and vigorous prints.

Chloride of Gold.—This valuable substance is generally sold in bottles or tubes containing 15 grains. It is very deliquescent, and unless hermetically sealed, can only be kept in solution. Break your tube, and dissolve the contents in a bottle containing 15 ounces of water, and label it accordingly.

Carbonate of Soda.—Dissolve 60 grains in 10 ounces of water, and bottle and label it also.

Hyposulphite of Soda.—Dissolve two ounces in 8 ounces of water, and label it.

HOW TO SENSITIZE THE PAPER.

Fill your dish to the depth of not less than half an inch with the 60 grain nitrate of silver solution already named. Cut your paper to convenient sizes suitable to your negatives, and lay it glazed or albumenized side downwards on the surface of the silver solution. When it has lain for about a minute, with the pincers lift up one corner and if there are any air bubbles remove them; replace the sheet and lift the diagonal corner for a similar purpose. Allow it to remain five minutes on the solution, then lift it off, taking care no solution runs over the back, and suspend it with an American peg to a line or edge of shelf in a closet or other dark place, when it can dry spontaneously. It is ready then for use.

Your paper ready, place your negative in the printing

frame, collodion side uppermost—be sure the glass is quite clean—and lay the paper on it, prepared surface downwards; put a few sheets of blotting paper behind it, next put the hinged back in its place and secure the whole tightly with the screws or other fastenings provided.

It is essential that the paper should be in very close contact with the negative to produce a "sharp" print, and you must observe that this pressure is uniform to prevent breaking it.

Expose it to the light and allow it to remain until printed. How long this operation will take depends on the power of the light and the density of the negative. In summer, a very short period is sufficient; and in winter, a whole day or longer may be required. To know how it is proceeding, undo the fastenings *on one side of the frame;* and by lifting up the hinged back, you can, without disturbing the position of the negative and paper, examine the latter and observe its progress. First, the general outline is marked; then, the deep shadows are produced; next, the lighter shades; and, finally, the delicate half tones. By these latter you must be guided. You must print till they are not only clearly out, but a few shades deeper than you would like them; because in the subsequent operations they will become lighter, and unless you make this allowance your print, when finished, will not be deep enough. A little experience will tell you how dark you should print. In printing portraits you must judge entirely by the *head;* get out all the half tones clear and distinct, so that the ultimate picture shall shew the features nice and round, not buried in black shade from being overprinted, or pale and flat from under-printing, but just such soft gradations as will make a pleasing likeness. This depth obtained, take it out of the printing frame and it is ready to be *toned* and *fixed.* The operations of preparing the paper, putting it into

the printing frame, examining it and taking it out, together with the toning should all be done either in yellow or very dull white light; for although the excited paper is not nearly so sensitive as collodion, yet a strong light, especially sunshine, will quickly spoil it for good printing.

HOW TO TONE THE PRINTS.

If you are producing several prints you may wait till they are all ready, keeping those first done in a drawer or other place secluded from light, but they should be toned and fixed the same day they are printed; for, although these operations may be deferred, the results are seldom so good. When ready, immerse them in a dish of clean water, removing air-bubbles, and move them about that the water may get freely between; allow them to remain five minutes; pour the water away and refill the dish, and again wash for another five minutes, moving them about as before, change the water a third time; this time the water should only be slightly milky; if it is more than this, the prints must be further washed. While they are soaking in the last water, pour into your 10-ounce measure glass 1½ ounce of the chloride of gold solution. Immerse a piece of blue litmus paper; it will be instantly turned red; now add cautiously, and stirring all the time, the solution of carbonate of soda, until the reddened litmus paper returns to its blue colour, then cease and make up the quantity to 6 ounces. Pour this *neutral toning solution*—for such it is—into another dish, and immerse the prints one at a time, and keep them moving about, removing air bubbles, for they are a frequent cause of stains. Until you gain experience you had better not have more than three or four prints in at a time. They must be closely watched, for they very speedily change from

their reddish brown to a purple tint; and if they have been printed deeply enough, the shades will pass to a purple black, while the whites will assume a delicate rosy hue. Some little experience is required to know when to take them out, but you may be guided by the general appearance as seen by looking *through* them, holding them up to the light. If they are purple when thus examined, they may be removed into a dish of clean water, to remain until they are all toned and ready to be fixed.

According to the depth to which you have printed, and the length of time they have been in the toning solution, so will the colour be. If you wish a rich chesnut brown, a very little toning will suffice; if you like a purple brown, tone deeper; and if a dark purple black, you must print and tone very deep. The colour of your prints will materially depend on your negatives. With a well-defined, soft, yet vigorous negative you may produce any tone; but from weak negatives you cannot produce good pictures. Prints kept too long in the toning solution become cold, grey, inky, weak, and flat.

If you are attentive, you will quickly gain experience enough to get with good negatives almost any desirable tone, by modifying the depth of printing and strength of toning. The time usually occupied is from two to five minutes. In winter time, the solution may be warmed, and it will tone quicker. As this solution will not keep, no more should be mixed than is likely to be used at one time. The quantity I have directed you to prepare will tone two dozen stereoscopics, or ten whole plates. The preceding instructions are mainly directed to highly albumenized prints; and a little modification is required for plain paper proofs, they should be printed rather darker as they have a great tendency to bleach during toning. The toning solution should be much more dilute than for albumen prints.

HOW TO FIX THE PRINTS.

Into your gutta-percha dish—which you must keep expressly for this purpose —pour your fixing solution of hyposulphite of soda. Immerse your prints in it, and allow them to remain for fifteen minutes, separating and moving them about, so that the solution may get freely to them all.

They will quickly change and lose some part of the beautiful hue they had in the gold solution, but this tint will be restored when they are finally finished. When the time has elapsed, they must be taken out, well drained, and then be well washed to rid them as much as possible of the fixing solution. For the first half hour they should be kept in running water, and, if your circumstances will permit, should be kept in for six hours, and finally soaked in hot water, and then dried. If you cannot give them the advantage of a running stream, change the water in which they are soaked every half-hour for the first three hours; then soak them all night, and next morning give them two or three changes, and finishing with hot water, let them be dried. This well washing is the security that your prints will not fade, for more are spoilt from neglect of this important but irksome process than from any other cause.

HOW TO MOUNT THE PRINTS.

When dry the print will be very curly, but if ironed on the back with a clean warm flat iron, it will lie smooth, and then it may be cut and trimmed as taste dictates.

Hot thin glue may be used to mount them on cardboard;

but starch, such as used for household purposes, and about the same consistency, is equally adapted. It should be used cold. To complete them, they should be sent to the hot-pressers, who, for a very small charge, will glaze or roll them, which will communicate a highly-finished appearance.

HOW TO PRINT BY DEVELOPMENT.

Another mode of printing is occasionally adopted where light only commences the operation, as in the production of positives and negatives, and the further production of the picture is by development. There are many circumstances in which this mode is very useful, especially when the solar light is too weak to produce prints in the usual manner.

The results are not quite so fine as by direct sun-printing, and are best adapted for large and bold subjects.

Albumenized paper is not used, but plain salted paper, which you must prepare for yourself as follows:—

Chloride of ammonium	90 grains.
Water	10 ounces.

Immerse the paper—Towgood's is the best—for five minutes, then hang up and dry; sensitize on a 45-grain silver bath with glacial acetic acid three minims to the ounce; when dry, expose under a negative till a very faint picture is seen, then take into the regular dark room, and placing it in a very clean dish, pour over it a saturated solution of gallic acid. It will take from five to twenty minutes to develope. When the print is fully out—you must get rather a strong impression, as it loses a little in fixing—wash it well in plain water, changing two or three times, then immerse in the hyposulphite fixing bath, already named for other prints. Allow it to remain ten minutes, then wash well, obeying all

the instructions already given under that head. Prints produced by this formula are a very good colour, and do not need toning.

DEFECTS, FAILURES, AND REMEDIES.

"Humanum est errare."

However it may be in other mortals, for a certainty, 'tis not in photographers to command success; and although I have given you clear and simple directions, which I have no doubt you will carefully follow, yet, My Worthy Pupil, I fear that you will not be exempt from many of those troubles which most of us have encountered.

It may be a melancholy satisfaction to know that the cleverest practitioners are subject to them in common with the less skilful; the difference, however, being, that the former by perseverance overcome them, while the latter give up the contest and are beaten.

As you have, no doubt, determined to belong to the first class, and with a view to aid you, I enumerate the most probable causes of failure.

Generally speaking, to point out the origin of a defect is also to suggest a remedy; when, however, this is not evident it will be stated. It is impossible to anticipate where your difficulties will be, for the experience of no two exactly agrees, but you must endeavour to *understand* the process, and to grasp the *spirit* of the directions. Above all things resolve to be neat and clean in your manipulations, cool in your manner, and exercise an observing eye, and you will certainly escape from nine out of ten of the beginner's troubles.

Whether a person shall succeed or fail in photography

depends very much on the spirit with which he commences. If he thinks the whole process a *mechanical* one, mainly a question of apparatus, baths, and developers, he has no pleasant future. When he gets into difficulty—and he soon does—he declares his chemicals are wrong, his bath is out of order, his camera is bewitched, and rushes from shop to shop to buy the last "patent never-fail collodion," or the marvellous greek-named lens that takes pictures in a few seconds less than no time, or some other be-puffed and be-advertised nostrum, instead of stopping at home and quietly finding out in what his trouble consisted. Possibly he has mixed his plain collodion and iodizing solution in reversed proportions, or strengthened his nitrate bath out of the un-labelled hypo bottle, or been trying to develope with his cyanide. Such a man soon wears himself out, declares, "it's no use trying, it's all chance," and attributes the success of skilful men to the use of "secret dodges."

As a contrast, observe another man, who begins quietly and steadily, and, getting into trouble, thinks it very probable that it is *he*, not the chemicals, that is wrong; and instead of throwing them down the sink, perseveringly proceeds, finally discovering that the same chemicals that gave him bad pictures now furnish good ones, the difference being only *in the mode of using them*. A man of this stamp, taking pride in his new acquisition, and not blind to his own deficiencies, reads the Journals, joins a Photographic Society, compares notes with his confreres, keenly enjoys a visit to a Photographic Exhibition, and speedily becomes an intelligent and clever manipulator.

DEFECTS COMMON TO GLASS POSITIVES AND NEGATIVES.

A darkening of the film all over, directly the developing solution is applied.—This defect, technically called "fogging," has several sources. It may exist in a small degree, only slightly obscuring the shadows of the picture, or so great as to prevent its appearance. Fogging often troubles the young beginner, and as it arises from many causes, it is often difficult to assign it to the right one. Sometimes deleterious vapours are the cause; as, the dark room being built over a stable and filling with reeking vapour; the room being newly painted with a slow drying paint; a leakage of gas; a bottle of ammonia with a bad fitting cork or stopper. A remedy for any of the above is simply to remove the cause.

In extremely warm weather the developing solution is much more energetic, and fogging may thus arise; remedy, dilute it one half, or double the quantity of acid. The following are, however, the most usual causes of fogging:—

Alkalinity of nitrate bath; remedy, addition of acetic acid till litmus paper is *slightly* reddened.

Extreme acidity of nitrate bath; remedy, addition of oxide of silver or carbonate of soda, until litmus paper is only slightly reddened.

Omission of acetic or citric acid in the pyrogallic developer; remedy obvious.

Over-exposure in the camera; remedy obvious.

Diffused light in the dark room. If yellow calico be used, it has perhaps become bleached, and must be replenished, or additional folds must be used. Sometimes chinks of unsuspected white light are the cause, if so, they must be stopped up.

Diffused light in the camera or the dark slide, admitted through a joint giving way, or an old screw hole, or the parts of the camera not fitting; remedy obvious.

Nitrate bath made with impure silver, or bad water; remedy, expose it to the sun for a few hours, shake up kaolin with it and filter; acidify it if necessary.

Newly-mixed collodion, especially when developed with iron; remedy, add acid to the bath till it works clear.

When you make any change, such as having a new camera, a fresh bath solution, or another sample of collodion, you may be able at once to suspect and perhaps detect the cause. When you have no such clue, you must adopt a systematic method for its discovery. The following is the method:—

First, examine your dark room, by covering your yellow window with some material that entirely excludes *all light.* Crevices and cracks admitting white light will then be seen, that before were unnoticed, and some of them may have shone on the plate during its preparation and caused fog. If these are found, they must be stopped up, and your annoyance is over.

If these be not the cause, next suspect the window, for though it admit only yellow light it may not be yellow enough. Yellow materials become bleached, and require renewing, especially yellow calico. To test your window, and it is very important that you be quite certain on this point, proceed as follows: collodionize a plate as usual, and immerse it in the bath; then cover up your yellow window entirely, or leave only the smallest possible chink, so that you can just see what to do. Take your plate out of the bath and put it in the dark slide. Now remove the covering from the yellow window and draw up the shutter of the dark slide *half-way,* to expose *only one half of the plate:* keep the plate to the light of the window

for, say, five minutes, then replace the shutter, close up the window as before, and proceed to develope your plate. Keep the developing solution on about the usual time that is required to produce a picture, for you will not be able to see what is going on; then wash and fix it. Now restore the light and examine the plate, and it must present one of the three following appearances:—Case A, the half exposed to the window is drab, and the half not exposed is quite clear and transparent; case B, it has a drab deposit, in other words, fog, all over it; case C, the plate is perfectly clear and transparent all over.

We shall examine each of these. Case A, shows that the yellow window is at fault, for the half of the glass exposed to it is fogged; but the other half is clear, therefore, sufficient actinic light passes through to injure the plate. The yellow covering, if bleached, must be removed, or more coverings must be supplied, trying a plate between each addition, until you have your window so yellow that a plate may be exposed five minutes without being fogged. Yellow glass sometimes allows light enough to pass through to fog the plate; it must then be removed, and a better sample put in its place. I have seen a piece of yellow-brownish glass, though very dark in colour, that admitted actinic light almost as freely as white glass. This is rare, but in photography you must try all things, and only hold fast to that which is good. The window being covered with the proper material, your fogging will be over, and case A, dismissed.

Case B, the plate darkens all over under the action of the developer, and you can distinguish no difference between the two halves; this shows that your window is quite right, and you must seek further for the cause. It must now lie between the bath, the collodion, and the developer. First, try the

bath; test it with a strip of reddened litmus paper, and if it changes to blue, the bath is alkaline, and an alkaline bath is a certain cause of fogging. Add acetic acid, drop by drop, testing between each addition, until blue litmus paper is *very* slightly reddened. Again try a plate, the fogging will probably not be quite gone but much reduced; add a little more acid until it entirely disappears.

Suppose, however, that the reddened litmus paper did not change colour, then test with blue litmus, and if it turn *very* red, then carefully neutralize with oxide of silver or carbonate of soda, until only a slight acidity remains; then resume your trial to see if you have expelled your enemy, for excess of acid, especially nitric, will cause fog. Should the test-papers show that the bath is neither very acid or alkaline, the probability is that the error is in the developer or the collodion.

Make up, carefully, a fresh developing solution, being particular, if it be pyrogallic, not to omit the citric or acetic acid. You may slightly increase the quantity of the latter, for some samples are weak, and you may happen to have one; the pyrogallic solution, unless it have its proper addition of acid, will always cause fog. If the new developing solution rid you of your difficulty, well and good; if not, you must suspect your collodion. Some collodions cause fog, though rarely, therefore get some fresh, and let it have a little colour, a pale golden for instance; for colourless collodions are more prone to fog than coloured ones. If you are not now relieved, you may assume that the nitrate bath is the defaulter, for it must be one of the three. Make up a new bath; and if you use good silver and clean water, you are almost certain to be out of your trouble.

Case C, the plate develops perfectly clean and transparent all over; this shows not only that the yellow window is all

right, but that the chemicals are not the cause; in fact, that the origin of the fog must be external to the dark room; and as nothing else but diffused light can now be the cause, we must seek to discover it. First, examine the dark slide well, in some unsuspected manner it may admit light. Next, place a plate in the camera, put the cap on the lens, draw up *half way only* the shutter of the dark slide, but do not uncover the lens. Let the plate remain thus for a full minute, then develope and fix the plate. The plate will either be one half fogged or it will be quite clear all over. If half be fogged, it shows that the camera admits light in some other manner than through the lens, and thus the fog is caused. To know where the light is admitted, remove the ground-glass; and excluding all light with the focussing cloth, put your head into the camera, the lens being still covered, and you will see the light streaming in. You may examine the interior of your camera in another manner. Place the dark slide in its place and draw up the shutter; remove the lens, and with the aid of the focussing cloth again examine the interior through the flange aperture. If any stray light be admitted, you will see it on the face of the plate. It is necessary when examining the interior of a camera to wait a few minutes and allow the eyes to get accustomed to the darkness, or you may deceive yourself, and think there is no light, from your momentary inability to perceive it. The cracks, crevices, or holes, being stopped up, your trouble is past.

Should your plate, however, develope clear all over, it will show that the interior of the camera is perfect. Next, replace the lens, uncover it, and removing the ground-glass or dark slide from the back of the camera, examine the lens tube; if there be reflection from the inner surface, or from the brass work, or the edges of the back lens, any of these may, in a

lesser degree, cause fog. Dead black varnish applied to the reflecting surfaces is the remedy in all cases. As another probable cause, observe whether a strong light falls on the lens; if so, change the position of your camera, or provide a shade to protect the lens.

If you have not now traced out the difficulty, having run through your chemicals and apparatus, it most probably is caused by an error of manipulation, such as over-exposure, or a deviation from the proper mode of development. It is scarcely probable that you could pursue this inquiry without already having a clue to the real cause; and I have gone through the series of exhaustive experiments to show you, that by this method of inquiry, you may succeed in tracing almost any trouble to its true source.

Transparent spots.—Causes: collodion not settled; bath requires filtering; dust in the camera; knocking dark slide when plate is in; bath not saturated with iodide of silver, or supersaturated with iodide of silver.

Opaque spots.—Causes: developer not filtered; dust falling on the plate while being coated; dirt, and dried fragments of collodion from lip of collodion bottle; dust and dirt from dark slide.

Streaky lines in the direction of the dip.—These are caused, in a new bath, by a deficiency of acid; in an old one, by the accumulation of ether and alcohol. Remedy: in the first, add acid cautiously till streaks disappear; in the second, mix with it an equal bulk of plain thirty-five-grain solution of nitrate of silver.

Sharp horizontal lines across the plate.—These are caused by hesitation in dipping the plate into the bath.

Collodion film mottled and thick.—The collodion requires diluting with a little plain ether.

The collodion film on drying, peels off the glass; it is full of honeycomb-like markings; the film has transparent, crapy, diagonal lines, especially where the deposit is greatest.—These defects all arise from inferior collodion; procure some of better quality.

Opaque white marks and streaks at the end of the plate where the collodion was poured off.—Keep the plate a longer time before you immerse it in the bath; if this does not prevent the markings, add a little plain *un-iodized* collodion.

Transparent insensitive mark at the opposite end to where the collodion was poured off.—The plate was kept too long out of the bath, and the upper part has become dry; the plate must be immersed sooner into the bath.

Markings like curtains and fringes.—When these do not occur from bad manipulation—and be careful not too hastily to decide—these faults may arise from the collodion or the bath, and the best remedy is to endeavour to obtain samples that will work without thus plaguing you. When an iron developer is used, it is important that you have the proper quantity of alcohol in it, as this causes the solution to flow easily and smoothly all over the plate, and allows the developing solution readily to combine with the silver solution which is on the film. When the developer flows in irregular greasy lines, there are sure to be abundance of stains from this cause alone.

DEFECTS IN GLASS POSITIVES.

The light parts are pale and misty, and what should be the dark parts are drab-coloured.—Over-exposure produces this effect; reduce the time in the camera, or place a smaller diaphragm in the lens to cause it to work slower. If this

treatment does not remove the mistiness, it may be produced by "fog."

The blacks are very deep and brilliant, but deficient of detail, and the lights rather dark.—The exposure in camera is not sufficient, or the developing solution poured off too soon.

The picture, after washing off the cyanide solution, has blue stains.—The developing solution has not been sufficiently washed away before the fixing solution was used.

The shadows of the picture are clear, but the light parts are chalky and deficient of half tone.—The developing solution has been kept on too long.

The picture is brilliant when wet, but on drying becomes dull, the shadows being misty blue instead of bright black.—Bad collodion is the cause of this defect.

DEFECTS IN NEGATIVES.

The picture very intense where the light has acted most, and nearly transparent in the shadows.—The plate is under-exposed and over-developed.

The shadows have nearly as dense a deposit as the high lights.—The plate is over-exposed.

The image will not intensify under the action of the pyro-gallic acid and silver solution.—There are many causes for this defect, and you must discriminate which is the most probable in your own case, and act accordingly. Bad collodion—inferior nitrate of silver—too much acid, especially nitric, in your nitrate bath—the exposure, too long or too short in the camera—the absence of sufficient nitrate of silver solution on the film or in the developing solution—cold and dark weather—deficiency of light—too small a stop used with long focus single lens.

The film floats off, or breaks away from the glass, during development, or subsequent washing.—Defect in the collodion, or carelessness in manipulation. Plate immersed in bath too soon, or kept out too long. The edges of glass not sufficiently roughened.

The formation of crystals under the film when dry.—The hyposulphite solution not washed away enough. Sometimes this will show immediately; at other times it may be days or weeks before being seen.

Irregular smears and stains.—Dirty glasses is the most usual cause, also lifting the plate out of the nitrate bath too soon; placing it in the dark slide before the greasy lines have disappeared; not draining sufficiently, and the solution accumulating at the bottom; from dirty and wet plate-holders in the dark slide; handling the plate with dirty hands; the developing solution not flowing uniformly; pouring the developer principally on one spot; plate immersed in bath too soon, or not soon enough; developing glass not clean.

DEFECTS IN PAPER PRINTS.

The paper does not print equally all over; has marbled or mottled spots.—The silver solution is too weak. If the *silver-meter* be used, and the strength kept up to at least 60 grains, this defect will never occur.

The print when finished has a disagreeable yellow tint, and on looking through yellowish-brown opaque patches are seen.—The print is not fixed; the hyposulphite is too weak, or has been in use too long, or the print has not been immersed long enough to dissolve the chloride of silver.

The whites and blacks are very brilliant, but a deficiency of detail in both.—The negative is at fault, under-exposed.

The prints are weak, cold, and slaty.—Under-printing and over-toning are the general causes. Over-exposed negatives produce weak prints deficient in proper contrast.

The prints are grey and mealy.—Over-toning and defective paper.

Red spots, streaks, and markings.—Defects in the paper, or the albumenizing, or both.

Prints will not readily tone, but remain of a brown, leathery hue.—Toning bath too alkaline: chloride of gold deficient in strength; the toning bath exhausted; the paper kept too long before being printed on, or after being printed kept too long before toning.

Metallic smears, spots, stains, finger-marks, &c. — These defects nearly always arise from bad manipulation, handling the paper with dirty fingers; allowing solutions to splash; putting the paper on a dirty table; dust and dirt in the printing-frame or on the pads used in the latter, or similar causes; or they may occur from bad paper.

A Few General Remarks.

The proposed course of instruction in the usual collodion process is now completed, and practice is only required to make you entirely competent.

Part II. contains useful information on various matters, particularly the preparation of sensitive dry plates. These, however, you should not attempt until quite competent in the use of wet ones.

From the progress you may be presumed to have made, the homely and familiar style in which the instruction has been hitherto conveyed will now cease, and the remainder of the information will be given in a more synoptical form.

PART II.

DRY COLLODION PROCESSES.

Collodio-Albumen Process.

The collodion best suited for this, and all other dry processes, is the non-contractile, or powdery kind. Clean the plates thoroughly and let them be quite dry before coating with collodion. Pour the collodion on as usual, and let it set well before immersing in the nitrate bath. A pneumatic holder should be used, so that the plate may be covered to all the corners.

Nitrate of Silver Bath.

Re-crystallized nitrate of silver ...	1 ounce.
Distilled or boiled rain water ...	12 ounces.
Glacial acetic acid...	½ ounce.
Iodide of potassium	2 grains.

Dissolve, filter, and the bath is ready for use. It will become discoloured, but this may be disregarded until almost port wine colour, when a few drops of solution of common salt, strength not important, may be added, and this with agitation and subsequent filtration will clear the solution.

When the plate is sensitized, place it in a dish half-filled with solution of common salt, 5 grains to the ounce, and allow it to remain while another plate is being prepared. Next remove it from the salt solution, and wash it well with clean water, and pour over its surface the following solution of iodized albumen.

Iodized Albumen Solution.

Distilled water	3 ounces.
White of eggs	3 ounces.
Iodide of ammonium	20 grains.
Bromide of ammonium ...	5 grains.
Chloride of ammonium ...	2 grains.
Liquid ammonia (fortis.) ...	10 minims.

Place these materials, together with some pieces of broken glass, in a bottle capable of holding twice the quantity, and agitate till the whole forms a froth. This solution will keep a considerable time, but must be filtered before using.

Allow this solution to flow backwards and forwards to well saturate the film; repeat this operation with a second portion, and then set it aside to drain. When the moisture is principally removed, finish the drying before a fire or by other convenient means.

In this process, all the above operations, including the sensitizing, may be done in open daylight without any disadvantage. The plate in this condition is insensitive to light, and provided it be kept dry, will remain good for any time.

To render it sensitive, heat it as hot as the hand will bear to dispel all moisture, when cool immerse it again in the nitrate of silver bath, *using only a yellow light*, then wash thoroughly in clean water, and dry in the dark.

These sensitive plates will keep good for a few weeks in warm weather, or even months in cold, if the last washing has been perfect; yet it is better to use them as soon as convenient after their second sensitizing. They will require about six times as long exposure as ordinary wet collodion,

but a little over or under is not very important; an error on the former side being better than the latter, the important point being to expose sufficiently long to bring all the detail in the deepest shadows.

Gallic acid or pyrogallic may be used as developers. If the former, put the plate in a dish and pour sufficient saturated solution of gallic acid over, and when the film has been wetted, add a few drops of a 30-grain nitrate of silver solution. The image will begin to make its appearance in a few minutes. This developing solution does not act quickly, but it produces the best results. From half an hour to an hour is the usual time required, sometimes much longer, if the plate has been under-exposed. Several plates may, however, be developing at the same time. They may be taken out and examined occasionally. If a sediment form on the surface, wash the plate, and while under the water use a little friction, employing a large camel-hair brush, cotton wool, or even the finger. Then return the plate to the developing solution, and continue the action. It is surprising how hard the film is, and what an amount of rough usage these prepared plates will bear compared with the usual collodion films. The development must be continued till all the details are entirely out, and the requisite density produced. It must be remembered that the deposit produced on these plates has a greater power of obstructing light than in the usual process; the same amount of density therefore is not required, or the finished picture will be too hard and chalky.

Pyrogallic acid solution (see page 23), to which a few drops of nitrate of silver solution have been added, may also be employed, the precaution being taken of well wetting the film first with clean water; it acts much quicker than gallic acid, and therefore requires more careful watching.

Saturated solution of hypo soda must be used for fixing these plates, not cyanide of potassium.

The above process is very certain, and with moderate skill the most beautiful results may be obtained.

Fothergill Process.

This dry collodion process differs from the preceding in being more simple. The plate is conducted through fewer operations, and the process is therefore more generally practised. Prepare the plate with a suitable collodion, and sensitize in a slightly acid thirty-five-grain nitrate bath, then wash it well; next re-sensitize the plate in a five-grain nitrate of silver bath. When the plate comes out of this latter, drain it well, and pour over the following solution:—

Albumen	1 ounce.
Water	9 ounces.
Chloride of ammonia	5 grains.

Allow this solution to soak well into the film, then pour it off, and finally wash well and dry.

This process is very certain, and provided the collodion is of the proper kind, and the manipulations carefully performed, will develope without any stains or defects. Under the proper conditions, that is, away from damp, noxious vapours, and light, they will keep their sensitiveness unimpaired for many months. Either gallic acid or pyrogallic may be used for developing as in the preceding process, but the latter is generally used.

The same remarks respecting the development already given, equally apply to this process, except that the film will not bear touching, being as delicate as in the wet process. Hyposulphite of soda is the best fixer.

The Tannin Process.

This dry process, introduced by Major Russell, is more simple than the last, and by its practitioners is considered to be in no respect inferior.

The plate is coated with a dry-process collodion, and excited in an ordinary negative thirty-five-grain nitrate bath, faintly acid. The collodion should be allowed to set well before immersing, and to remain in the bath rather longer than usual; then drain and wash it well under the tap, and allow it to lie in a dish of water, while another plate is being sensitized in the bath; next pour over sufficient solution of tannin, fifteen grains to the ounce, to well cover it. Allow it to flow backwards and forwards to well permeate the film; then pour a second portion over in like manner, throw the solution off, drain the plate on clean blotting paper, and dry by heat, or spontaneously.

The plate is developed with pyrogallic acid, three grains to the ounce, to which is added a tthe time of using an equal bulk of a solution composed of nitrate of silver, four grains; citric acid, six grains; water, one ounce.

The exposure is much the same as for the processes already named, about six times longer than for wet plates. The development is almost as quick as wet collodion. Hyposulphite or cyanide may be used for fixing. This process is excellent for producing rich-toned transparencies.

There is a tendency with some kinds of collodion for the film on development to leave the glass. This may be avoided by varnishing the edge of the film with a camel-hair pencil, about an eighth of an inch all round, before it is developed. This binds the film firmly down. The process has not been

sufficiently long in use to speak of its keeping qualities, but there is reason to suppose that the plates will retain their sensibility unimpaired for a considerable time.

COPYING AND ENLARGING.

Though portraits and views engage the principal attention of photographers, yet copying prints, drawings, paintings, &c., is a very interesting branch. Pictures may be copied of same dimensions, or of larger or smaller sizes than themselves. To obtain a reduced copy of any engraving, for example, is very easy. The glass must be removed, the picture placed in a good light, and arranged vertically and exactly square with the front of the camera. The latter should be quite horizontal, with the lens directed exactly to the centre of the prints. Place the camera at the proper distance to produce a picture on the ground-glass of the required size.

A diaphragm must be placed in the lens sufficiently small to cause the definition to be equally good on the edges and in the centre.

Generally speaking, landscape lenses are best adapted, but portrait lenses with small diaphragms will answer when the copies are not of large dimension.

When a drawing is required to be reproduced the same size as itself, the difficulties are greater. It will be desirable to use either a large portrait lens with a small stop in the centre, or a long focus single lens, and use only one-half or two-thirds of the field it is supposed to cover. Unless these precautions be taken, if the picture be any size, the marginal lines, instead of being straight, will be bowed outwards.

The orthoscopic lens was intended to correct this error,

but its fault is of the opposite kind, a tendency to curve the lines inwards.

Where absolute accuracy is desired, Mr. Sutton's triplet lens, or that brought out by Mr. Dalmeyer, appears to be be most perfect, as it renders vertical lines neither barrel-shaped or pincushion-shaped, but literally straight.

Pictures are sometimes required to be copied of an enlarged size. Small portraits on the 1/9, 1/6, or 1/4 plates enlarged to the 1/1, 10 by 8 or 12 by 10 sizes are the most usual examples. For this work a *copying camera* is required, that is, one with a long-expanding body, which should be of leather, accordion-fashion, so that it may be used at all distances.

The size of this camera will be determined by the dimensions of the largest plates proposed to be used, the focal length of the enlarging lens, and the number of times the copies are to be magnified.

Let a case be supposed: it is required to enlarge a 1/9 or $2\frac{1}{2}$ by 2-inch plate to fill a 10 by 8-inch one. For this work a good quarter-plate lens provided with Waterhouse diaphragms will answer. The equivalent focus of these lenses is usually about six inches. The enlargement required in the present instance is four times, linear measure. The distance the ground-glass should be from the back lens must be calculated to know the length of the camera required. The rule that determines this is simple and easy to be remembered: *multiply the focal length of the lens to be used by the number of times of enlargement, and add the focal length to the product.* Thus the picture is to be enlarged four times, the focal length of the lens is six inches, four times six are twenty-four; now add the focal length—six inches—and thirty inches is the distance for the ground-glass to be from the back

lens; therefore, a camera that will expand to three feet will be ample. The distance for the picture to be placed in front of the lens is more than six and less than twelve inches. The size and length of camera obtained, the picture may be placed in a strong light, and, after a little adjustment to get the exact dimensions and correct focus, the rest of the operations are as usual. It will be necessary to use a small stop, and give a long exposure. Pictures thus enlarged are quite sharp, but are often somewhat coarse. This is, however, of little consequence when they are to be coloured by an artist.

It is sometimes advisable to secure the enlargement by two or more operations. To this description of work there is literally no bound, except that gradual loss of fineness and delicacy that takes place at each operation.

Negatives are sometimes thus enlarged; a magnified transparent positive is first obtained, which is again copied, and a still larger negative produced. A special camera or a dark-room, with an aperture opposite a window in which to place the glasses, is required for these operations.

THE SOLAR CAMERA, AND HOW TO PRODUCE LIFE-SIZE PICTURES.

By the method of copying already described, pictures can be obtained considerably enlarged and with a satisfactory degree of definition; but a bound is soon reached in consequence of the weakness of the light when distributed over so large a surface. To meet this difficulty an instrument, the Solar Camera, has been invented by an American gentleman, Mr. Woodward, which supplies the means of illumination in so superior a degree that a new impetus has been given to the production of pictures by enlargement.

The instrument is based on the principle of the solar microscope, and is intended to be used in direct sunshine. It consists of a large, strong box, some 11 inches square, with sliding adjustments, like an ordinary camera. The front has adaptions for various lenses, but an ordinary ½-plate portrait lens is the one usually employed. Inside of the camera, and near the back, is placed a large plano-convex condensing lens, 9 inches in diameter, 17 inches focus, with the plane side inwards. Firmly attached to the camera back is a glass mirror, about two feet long, and nearly a foot broad. The picture to be enlarged is placed in a moveable partition between the condenser and the portrait lens.

To use this instrument, a room with a south aspect is selected. A strong table or bench is placed under the window to support the camera. It is placed with its back close to the window, all the light from which should be stopped out except about a square foot, through which the mirror should pass, and a small portion of it made yellow to see to work by. A few feet from the camera is placed a screen on which is received the enlarged image, magic-lantern fashion. This dark chamber becomes, in fact, a huge camera in which the operator conducts all his operations. The picture to be copied must be a weak glass negative, or over-exposed positive, with abundance of detail in the shadows and not too dense in the high lights. An ordinary negative will not produce good pictures, being too opaque.

The picture should be very clear, clean, and sharp; it should not be varnished. Any size under a 1/1 plate may be copied, but a 1/3 or 1/2 is best. A sun-shiny day must be selected, and the mirror so turned that it catches the solar rays and reflects them on the condensing lens. The size of the picture to be produced is determined by the

distance the receiving screen is placed from the portrait lens; the further it is removed, the greater the enlargement. The apparatus must be so adjusted that, when the picture is exactly in focus, the solar spark produced by the condensing lens must be precisely in the centre of the front surface of the portrait lens. By means of rack-work attached, the mirror can be moved in any direction to follow the motion of the sun. These movements can be made *inside* the room, which is a great convenience. Pictures may be obtained without the sun, but they are much superior with it, for one of the advantages of the instrument consists in the mass of light that is collected and concentrated on the negative; hence a greatly enlarged, yet brilliantly illuminated, image can be obtained. A picture can be directly printed on albumenized paper in from one to three hours, on favourable days in less time; but the mode generally adopted is to use a "development" process as described in page 36. A few seconds exposure is then sufficient. The developing is conducted as there described, and, with moderately careful management, very satisfactory pictures can be produced, and certainly much better in brilliancy, sharpness, rapidity, and delicacy, than by any other enlarging means.* So far as *size* is concerned, the operator is bounded only by the troubles of manipulation and *materiel*, otherwise there would be no difficulty in enlarging portraits to colossal proportions, and increasing half-plate pictures to ten feet dimensions. It is not to be supposed that the same degree of delicacy of definition is

* As this camera is patented in this country, all purchasers receive much more elaborate directions than it is possible to include here; the object in the present instance being mainly to describe the general nature of the instrument and bear testimony to its merits.

retained when this great enlargement is attempted, but the general truthfulness of effect and absence of distortion is really remarkable.

DIAPHRAGMS OR "STOPS" IN LENSES.

Diaphragms or stops are discs of metal or card-board with circular apertures placed before or between the lenses.

Their use is to produce clearer and more distinct definition, especially on the margin of the picture; also to cause near and distant objects to be in focus at the same time. In single or Landscape lenses, they are placed some distance in front; and in Double combination or Portrait lenses, they are placed either in contact with the front surface of the anterior lens, or midway between the lenses. Their purpose is always the same, to cause increased "sharpness;" for, *the smaller the diaphragm, the more perfect the definition and the greater the depth of focus;* and also the longer the time required for exposure.

The old-fashioned mode of placing the diaphragms in a portrait lens, immediately in front, though possessing a few advantages, is much inferior to the more recent method of placing them between the lenses. There are several methods of doing this, but the most ingenious is that introduced by Mr. Waterhouse—to whom we are also indebted for alkaline gold toning—of inserting the diaphragms through a slit in the lens-tube.

This plan is so very simple and effective, for the stops can be instantly changed without touching the lenses or disturbing the focus, that no portrait lens should be considered complete unless so furnished. Old lenses can readily be altered and

have these improved diaphragms without disturbing the glasses.

As many young photographers, and some older ones, do not sufficiently appreciate the value of diaphragms, a few words on their use may be in place.

Landscape lenses, from their nature, require to be used with small stops. They must always be placed in advance of the lens; and though there is no absolute point where they should be, the optician places them at such a safe working distance as will suit the majority of purposes.

Portrait lenses are supposed to be sufficiently perfect to be worked without stops. This is, however, a great mistake; for in consequence of all the definition being on one plane, and that a curved one, it is impossible to get complete sharpness all over on a flat glass, and more especially when the lens is but a few feet distant from the sitter. The objections to the use of diaphragms with these lenses, have been the increased length of exposure required, the decrease of the field of the lens, and the inequality of illumination, the centre of the field receiving so much more light than the margin. These objections, however, apply mainly to the old method of placing the stops before the front lens. When they are placed in the centre, the field is not curtailed but slightly extended, the light is also more evenly distributed, and with the same size of aperture the required increase of exposure is much less than by the old method. Seeing that so many of the objections are either removed or mitigated, it is to be hoped that a better style of pictures will be produced, and that the superior delicacy of definition and depth of focus obtained by the best operators, by the liberal use of diaphragms, will become more general.

As a regular practice no portrait lens, unless it be of very

long focus, should be used with open aperture; but the smallest sized diaphragm, that the circumstances will allow, should be employed. The open aperture should be considered as a reserve of force, to be used only when other means fail, and legitimately applicable solely to young children, very nervous persons, palsied subjects, moving objects, &c., or under like conditions where motion is not under control. It is excusable in wintry weather to use short focus lenses and open aperture; but it should never be forgotten, that what is gained in time is lost in definition, and that during the other three parts of the year only, a few seconds longer exposure with the use of a diaphragm, makes the difference between a picture being sharp nearly all over, and one where a spot or two only are in focus and the rest woolly and indistinct.

There is a certain desirable and harmonious distinctness that should be distributed over every picture; the most important parts, and those nearest to the eye, being the best defined; and receding objects, or parts of objects, losing their distinctness as they retire. Microscopic sharpness, and general haziness, are equally undesirable; the happy medium to be aimed at being that natural blending of softness and sharpness that characterize the works of the best artists, and which can only be secured by the liberal use of diaphragms and the exercise of good taste.

HOW TO ARRANGE THE LENSES IN A PORTRAIT COMBINATION.

The lenses in a portrait combination are occasionally removed from their cells for the purposes of cleaning. Generally speaking it is sufficient to unscrew the mountings and wipe with chamois leather the two surfaces exposed. They

can then be easily replaced; for the brass fittings are usually so made that if by mistake the cells are screwed into the wrong places, the hood, or projecting shade, will not go on. The mistake is, therefore, easily detected and corrected. When, however, the lenses themselves are taken out of their cells—and except for curiosity this is rarely required, for the inner surfaces do not become dirty like the outer ones—the case is very different, for they may be variously transposed, and thus rendered incapable of producing good pictures. There is risk also of breaking one of the glasses of the back lens in screwing it in, unless it be put together in the proper manner. Many good lenses have been condemned as hopelessly bad through being thus transposed.

In a portrait combination there are four lenses in all; the so-called *front* and *back* lenses being really each formed of a pair. The front ones are always cemented together, and may thus be easily taken for one lens; the back pair are distinct and are separated from each other by a narrow ring.

To place them in their proper positions, proceed as follows:—take the front lens—the pair cemented together—and observe that one surface is considerably curved and the other almost flat; place the lens in its cell so that when screwed into the tube the curved side will be to the sitter. The two glasses forming the back lens are very unlike each other, one is thick in the centre and thin at the edge, the other thick at the edge and thin at the centre; put the thin-edged one first into the cell resting on the least-curved side, next put in the ring, and then the thick-edged glass, concave side towards the other lens; fix them in their places with the part provided, and screw the cell in its place.

With many portrait lenses there is an arrangement whereby

the front lens may be used as a landscape lens; when thus employed the *flat* surface must be presented to the object.

COLOURING PHOTOGRAPHS.

The one drawback to the entire truthfulness of photographs is the absence of the natural tints. Considering the rapid improvement the art has made, it is not too much to expect that even this crowning triumph may be achieved in the brilliant future of photography. In the meantime, recourse must be had to the artist's pencil.

Although landscape scenery exhibits some of the grandest effects of natural colours, yet the exquisite delicacy and richness of tone of good photographs in some degree compensate for the absence of colour. In portraiture, mainly, the great want is felt.

Although it is desirable to retain the colour of the dress and subsidiary portions of personal attire, yet in a portrait the colour of the complexion is almost as important as the form of the features. The photograph may truly give the general contour, and in some degree indicate the complexion; yet without colour it is scarcely possible to adequately distinguish between the fair skin, blue eyes, and yellow hair of the blonde, and the black hair, dark eyes, and swarthy hue of the brunette; the bronzed cheek of the mariner, and the tallow tint of the city clerk; the farmer's red face, and the weaver's white one; the fair-haired Saxon, and the dark-skinned Celt.

The artist's pencil must be called in to make a perfect portrait.

Portraits on paper are coloured in oil, water-colour, or by crayons. Crayon or chalk is principally adapted for the very large sizes where boldness and breadth are required; water-

colour suits small subjects where great delicacy and minute finish are necessary, such as small pictures in leather cases, lockets, brooches, and miniature work generally; and oil-colouring fills up the intermediate portion, in which is included the great bulk of portraits. In the early days nearly all the pictures were finished in water-colour; oil painting has, however, gained the ascendancy from its superior boldness and vigour, and also from its supposed greater stability. Colouring in oil admits of great variety, from the solid substantiality of the old-fashioned family portrait to the almost miniature-like delicacy of ivory paintings. There is a style getting into general use of slightly colouring photographs in oil, in which the whole of the original photograph is distinctly retained, and only so much of the picture tinted as is required to complete the *vraisemblance*. This method has the recommendation of being inexpensive and incurring little risk of losing the likeness.

It is beyond the scope of the present work to go farther into this subject, and for more information the reader is referred to a very useful and well-written manual—"Harmonious Colouring," published by Newman—in which the subject is treated at length. It is brimful of information, and cannot be perused but with profit by both artist and photographer.

COLOURING GLASS POSITIVES.

To colour glass positives does not require the same amount of skill as paper pictures; hence, while the latter are almost invariably handed to the professional artist, the former are usually done by the photographer himself. A steady hand, a delicate touch, and a little artistic feeling are the qualifications required.

The colours are used in the state of dry powder. They are prepared in all desirable varieties of tints, and are sold in small bottles ready for use. Those supplied by Messrs. Newman are universally acknowledged to be very superior. The brushes usually employed are very small ones attached to sticks with metal ferules. A better plan is to use the smaller sizes of camel-hair or sable brushes; and some little time before using, to wash them in clear water, and drawing the points through the lips allow them thus to dry. When required for use, break the smallest portion of the point of the brush by pressing it on the thumb-nail, and taking a little dry colour on the end, proceed by a delicate circular pressure to tint the picture, the colour adhering to the slightly rough surface of the collodion film. No absolute rules can be given, but taste and judgment must dictate the choice of colours. In a portrait, for instance, the first thing is to note well the complexion of the person, and to select such tints as will make the photograph a good likeness. Some faces are red, some pale, others swarthy, and the tints must be chosen accordingly. A good plan is to commence with the cheeks, placing a little carmine on the highest points, if the person have a good colour. Then with a tint corresponding with the rest of the complexion, work down this tint till it is softened into the rest of the cheeks; next proceed with the chin, then the forehead. Very little colour will be required for the latter as even the ruddiest seldom have much colour in the forehead. The lower lip requires a deeper colour than the cheeks, but the upper one being in shadow will generally be best left alone.

In well-lighted pictures there are certain high lights, as down the nose, on the prominent part of the forehead and chin, &c.; these must be carefully preserved. Indeed, the

rotundity of the head may be materially increased or destroyed according to the skill with which the tints are used. The eyes may occasionally be touched to deepen their colour; but the greatest care is required. Light brown or sandy hair may be tinted on the high lights. Very dark brown, black, and grey hair will not need colour, being sufficiently near their natural appearance.

In tinting drapery as little colour as possible should be used; for however carefully applied, it will be sure in some degree to hide that delicate definition of texture which constitutes the great charm of photography. A little colour should be applied to the highest lights only, then with another brush soften the edges of these high lights into the half tints, allowing the shadows to remain untouched.

Flowers in bouquets, and ladies caps, &c., may be delicately touched with wet colour. The iris of the eye, and the bright spot of light may also be put in with similar means. Rings, chains, and jewellery generally are indicated by gold and silver shell. Some photographers are very skilful in introducing little bits of landscape and interiors into their backgrounds. These should never be made prominent; but when only indicated rather than worked out, enhance the effect and improve the picture by "throwing up" the portrait itself.

Some persons colour the picture before it is varnished, and go over the principal parts a second time; others colour entirely on the varnish. There is no rule, and each one may work in that manner by which he can produce the most pleasing effects. The golden rule should never be forgotten, that it is better to use too little than too much colour; for few things are more offensive to good taste than an over-coloured portrait.

ENGLISH WEIGHTS AND MEASURES.

Troy or Apothecaries Weight.			Avoirdupois Weight.		
20	grains	= 1 scruple			
60	,,	= 1 dram	27⅓	grains	= 1 dram
480	,,	= 1 ounce	437½	,,	= 1 ounce
12	ounces	= 1 pound	16	ounces	= 1 pound

FLUID MEASURE.

60 minims = 1 dram
480 ,, = 8 ,, = 1 ounce
160 drams = 20 ounces = 1 pint
8 pints = 4 quarts = 1 gallon

WEIGHT OF DISTILLED WATER

AT 60° FAHRENHEIT.

1 fluid dram weighs 54·7 grains avoirdupois
1 ,, ounce ,, 437½ ,, ,,
1 ,, pint ,, 1¼ lb. ,,
1 ,, gallon ,, 10 lbs. ,,

FRENCH WEIGHTS AND MEASURES.

1 gramme *weighs* nearly 15½ English grains (15·433)
1 ,, = 10 decigrammes = 100 centigrammes = 1000 miligrammes
1 kilogramme = 1000 grammes = nearly 2¼ lbs. avoirdupois (2·247)
1 litre *measures* nearly 35¼ fluid ounces (35·2)
1 cubic centimetre *measures* nearly 17 minims (16·896)

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PART I.

PART II.

LONDON: THOMAS PIPER, PRINTER, PATERNOSTER ROW.